

Some nondifferentiable multiobjective programming problems[☆]

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Abstract

In this paper it is shown that a relaxation defining the class of generalized d-V-type-I functions leads to a new class of multi-objective problems which preserves the sufficient optimality and duality results in the scalar non-differentiable case, and avoids the major difficulty of verifying that the inequality holds for the same kernel function. The results obtained in this paper generalize and extend the previously known results in this area.

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1. Introduction

The field of multi-objective programming, also known as vector programming, has grown remarkably in different directions in the settings of optimality conditions and du-

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ality theory since the 1980s. It has been enriched by the applications of various types of generalizations of convexity theory, with and without differentiability assumptions, and in the framework of continuous time programming, fractional programming, inverse vector optimization, saddle point theory, symmetric duality, variational problems and variational inequality problems, etc.

Convexity plays a vital role in many aspects of mathematical programming including sufficient optimality condition and duality theorems see, for example, Mangasarian [13] and Bazaraa et al. [3]. To relax convexity assumptions imposed on the functions in theorems on sufficient optimality and duality, various generalized convexity notions have been proposed. Hanson [8] introduced the class of invex functions, see also [5]. Later, Hanson and Mond [10] defined two new classes of functions called type-I and type-II functions, and sufficient optimality conditions were established by using these concepts. Rueda and Hanson [24] further extended type-I functions to the classes of pseudo-type-I and quasi-type-I functions and obtained sufficient optimality criteria for a nonlinear programming problem involving these functions. Kaul et al. [12] considered a multiple objective nonlinear programming problem involving generalized type-I functions and obtained some results on optimality and duality, where the Wolfe and Mond–Weir duals are considered. Univex functions were introduced and studied by Bector et al. [4]. Rueda et al. [25] obtained optimality and duality results for several mathematical programs by combining the concepts of type-I and univex functions. Mishra [16] considered a multiple objective nonlinear programming problem and obtained optimality, duality and saddle point results of a vector-valued Lagrangian by combining the concepts of type-I, pseudo-type-I, quasi-type-I, quasi-pseudo-type-I, pseudo-quasi-type-I and univex functions. Aghezzaf and Hachimi [1] introduced new classes of generalized type-I vector-valued functions and derived various duality results for a nonlinear multiobjective programming problem.

It is known that, despite substituting invexity for convexity, many theoretical problems in differentiable programming can also be solved, see Hanson [8], Egudo and Hanson [7], and Jeyakumar and Mond [11]. But the corresponding conclusions cannot be obtained in nondifferentiable programming with the aid of invexity introduced by Hanson [8] because the existence of a derivative is required in the definition of invexity.

There exists a generalization of invexity to locally Lipschitz functions, with derivative replaced by the Clarke generalized gradient, see Craven [6], Reiland [23], Mishra and Mukherjee [18,19], Mishra [14,15], and Mishra and Giorgi [17]. However, Antczak [2] used directional derivative, in association with a hypothesis of an invex kind following Ye [28]. The necessary optimality conditions in Antczak [2] are different from those cited in the literature.

In the present paper, we consider a nondifferentiable and multiobjective programming problem and derive some Karush–Kuhn–Tucker type of sufficient optimality conditions for a (weakly) Pareto efficient solution to the problem involving the new classes of directionally differentiable generalized type-I functions. Furthermore, the Mond–Weir type and general Mond–Weir type of duality results are also obtained in terms of right differentials of the aforesaid functions involved in the multiobjective programming problem.

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